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TEMPORARY INDUSTRIAL FELLOWSHIPS.

BY ROBERT KENNEDY DUNCAN, PROFESSOR OF INDUSTRIAL CHEMISTRY AT THE UNIVERSITY OF KANSAS.

THAT all industries have problems of a scientific nature may readily be discovered by simply inquiring of any manufacturer whatever. In these days, he will not only admit that he has these problems, but he is apt to complain, even bitterly, that he cannot find the men to solve them, and, moreover, that their continued lack of solution means, imminently, loss or failure to his individual instance of the industry. In the past few decades, while these problems were present, ever and always, they were masked, or, at any rate, their importance was masked, by the wealth of raw materials that lay everywhere at hand; by an aggressive tariff, that concealed from the manufacturer the practical presence of the problems; and by a certain facility in what may not unfairly be called business intrigue, which enabled him to supplement the waste in his factory by combinations for the elimination of competition; finally, the needs of the population have been so open-mouthed and hungry that the cruel edge of competition lay long unsharpened.

Now, however, in all industries, conditions are radically changing. The unexampled and wasteful production of the country bids fair to result in overproduction; in the practice of business intrigue each manufacturer has sharpened the face of his rival to a razor-edge; the wealth of raw materials has in large measure been aggregated into the holdings of a few men, who release these products to the manufacturer only at an onerous and distressful rate; the tariff, high as it is, is still unable to exclude many articles of foreign manufacture made under the intelligent supervision of modern science; and, for we live in parlous times, the tariff, itself, on its present high pinnacle lies in unstable equilibrium. The steady growth in the introduction of articles of foreign manufacture made with the aid of modern science is no mere silliness of the imagination. To one who, like the writer, has spent a year in Europe in the continued investigation of the extent to which science is applied to modern industry, the situation could only be characterized adequately through utterance that would be sensational. The Germany of the days prior to the Prussian conquest has passed away and the new Germany is a Germany of workshops; and workshops, too, in which, in the intelligent application of means to ends, which constitutes the scientific method, in the eagerness to harness new knowledge to their service, and in a willingness to spend money in intelligent experimentation, there is demonstrated a condition of almost perfect functioning. In France, also, though not with the same method, but in a spirit as eager and intelligent, there is the same turning over into sensible scientific conduct of the traditional industries and the same activity in the establishment of new ones. In Italy, too, long deemed a land of languorous ineptitude, the scientific spirit has stirred into active being a multitude of new industries. Even in England, there is abroad in the land the spirit of applied science.

Nowhere else, however, is there in evidence the same system of coordination and cooperation in industry as there is in Germany. The universities are coordinated with the industries, and so are the banks and the great steamship companies; all of them constituting a system of cooperation so observable that it forces the conclusion that it is not the unconscious outcome of the German character, but the result, rather, of an active and conscious plan.

Apposite to this statement, and indeed typical, is the case of a German university professor who discovered a new process. His first step was to present it to the experts of one of the great factories concerned; his second was to present it to the Deutsche Bank, which employed its own experts to report on the validity and practicability of the process. As a result, the professor with his discovery, the Deutsche Bank with its funds, and the company with its immense facilities for investigating the discovery on a large scale, formed a little company of three for the exploitation of the process. How impossible would be such an arrangement in this country!

Thus it is in Europe; but what about America? It is no mistake to say that American manufacture is a chaos of confusion and waste. It is no mistake, either, to say that the American manufacturer now knows it. This confusion and waste, it should be said, is chemical, not mechanical. Along the lines of mechanical contrivances America need acknowledge no peer. But mechanical contrivances are but a small part of the operations of modern industry. Since every manufacturer deals with the modification of substance, and substance is the business of chemistry, every manufacturer is just exactly to that extent chemical. That this fundamental truth has not, in the past, been recognized is due largely to the fact that the manufacturers of the last generation were, generally speaking, men endowed with great natural abilities but of small education—men who, starting as factory "hands," worked themselves up through the grades of foreman and superintendent to managerships and presidencies. To such men, science and the scientific method meant literally nothing; it was outside their ken, and they had all the impatience and disdain of the "practical man" for what they called the "theoretical fellow." With the growth of the combinations of capital, however, and with the coming of a schooled generation of business men, matters have assumed a different aspect. Naturally enough, the large organizations of capital have been the first to appreciate the working value of the leaven of new knowledge, and it is in marked degree due to this appreciation that they have successfully differentiated their factory processes from those of small companies or individual manufacturers. The small manufacturer, failing in the stress of competition, often ascribes to business intrigue and combination a competitive success that actually belongs to modern chemistry. There is, as a matter of fact, a singular difference to-day between the factory practice of different companies in any one industry. This is for the reason that the larger companies, while employing expert scientific advice with huge resulting economies, keep their improved processes strictly to themselves, for, obviously, in applied science, it does not pay to tell. The result is a situation that to the smaller manufacturer grows more and more intolerable.

There is a question that has come to the writer out of every quarter of the English-speaking lands, and from trust organizations and small manufacturers alike: "How can we utilize modern knowledge?"

This question, the writer believes, has found its answer in a practical form in a new relation which he has suggested and initiated between the University of Kansas and the people of the country. It lies in giving the manufacturer the privilege of founding in the University a Temporary Industrial Fellowship for the investigation of a specific problem, the solution of which would mutually and materially benefit both the manufacturer himself and the public.

The consistency and propriety of this aid are seen in the accepted dictum that the University stands for the whole good of man — for the *uplift* of man. The absolute function of the University is not only the increase and diffusion of knowledge among men, but of *useful* knowledge. It must be remembered that it is only through useful knowledge that the people have gained the material blessings of our new civilization. Furthermore, it must be remembered that every useful agent in our new civilization is the product of an industry, and that it is only through the industries that these new products of civilization can go to the people. New mechanisms—such as the telegraph, the telephone, the electric light, the X-ray bulb—new medicines, new dyes, new steels, new and improved products that surround us on every side come to us only through the industries. People confuse the blessings of the products of industry with the mixed blessings of the exploiters of industry. Every discovery utilizable by industry is a thread in the fabric of a future and more gracious civilization. The exploiters of industry, on the contrary, are a phenomenon belonging of necessity only to our age. Future men may, and doubtless will, modify and control their powers or altogether eliminate them; but, in the industry which they exploit, there lies the whole hope of the betterment of the world. For science, waste-abhorring, will introduce such economies; and science, the spirit of intelligence, will discover such new processes and agents and powers that man, in the far future, but inevitable, readjustment, will find through science the chance to live. Consequently, the University may with entire propriety lend itself to the increase of useful knowledge, all the more since it forwards this useful knowledge by simply affording the manufacturer the opportunity of helping himself.

That the University can, actually and practically, forward the progress of industry is seen in the consideration of two facts.

First, is the application of new knowledge: the problems that may be solved by the layman in science, even though that layman be a foreman in the factory, have practically disappeared—problems having obvious and apparent answers have all been solved. Again, owing to the continuous acceleration of modern knowledge, the field of science, so long as it is not compared with that which still remains to be discovered, is prodigious in extent—and it is only in the universities that such knowledge is practised and known. It is this knowledge, born and bred in the universities, that is creating industrial revolutions. It may be said on this point that the industries have in their employ their own chemists and other men of science, but such a statement would be barely a partial truth. It is true that the large trust organizations do employ one or two men of science, and the success of these organizations—that is, their real, and not adventitious, success—rests upon the service of these men. As for the smaller manufacturers, however, they employ practically none; their "chemists" should be quotation-marked to mean laboratory boys, trained only to do one testing operation over and over again. Even those men of unquestionable scientific training that are at present employed by the factories are by the very fact of that employment incapable of solving its problems. As one large company recently informed us, such men "cannot see over their own fence," they "cannot see the wood for the trees," they "are killed by their own routine." To take a specific case: A chemist employed by a glass-factory may, sensibly and accurately, analyze the furnace-gas and the soda and lime and sand used in the making of glass, but he could not possibly determine the science of glass-making; that kind of a service was rendered by professors from the University of Jena. The fact is that, in these days, the really important problems can only be solved by the rendering of aid from outside—by men attacking the problem with a perfectly open mind and armed with a wide range of new facts apparently unrelated but potentially applicable. We see this in the actual facts of the case—that it is from the large universities of the world that industry has received in recent years its most valuable gifts. It is well within the mark to say that, during the last ten years, three-fourths of the discoveries of industrial importance have emanated either from the universities or from men whose knowledge was obtained therein.

But the beneficence of the University extends not only to the solution of an industrial problem, but, also, to the furnishing of men. That "good men" are scarce is, of course, a truism; but it is terribly apposite in these days. The modern manufacturer advisedly economizes in everything but salaries, and the very considerable salaries paid to good men is ample evidence of their rarity. Now, the purlieus of adolescent "good men" are the laboratories of the University. There it is that men are "tried out," and there it is, too, that men are known better than they know themselves. When, therefore, the University accepts from a manufacturer the foundation of an industrial fellowship, it not only provides an expert intense attempt to solve a problem by the application of the newest of new knowledge, but, as well, it provides for that industry a "good man," whom the industry would do well to cherish, or, at any rate, the best man available.

The character of these Fellowships is best demonstrated by a specific case such as we give below:

The A. B. Industrial Fellowship.

For the purpose of promoting the increase of useful knowledge, the University of Kansas accepts from *The A. B. Company, of Chicago,** the foundation of a Temporary Industrial Fellowship to be known as *The A. B. Fellowship.*

It is mutually agreed and understood that the conditions governing this Fellowship shall be as follows:

The exclusive purpose of this Fellowship is *The discovery of Improvements in the Chemistry of Laundering,* to the furtherance of which the holder of this Fellowship shall give his whole time and attention.

The Fellow shall be appointed by the Chancellor of the University, the Director of the Chemical Department and the Professor of Industrial Chemistry; he shall be a member of the University and shall pay all regular fees, including laboratory fees; he shall work under the advice and direction of the Professor of Industrial Chemistry, and he shall forward periodically, through the Professor of Industrial Chemistry, reports of the progress of his work to *The A. B. Company.*

For the support of this Fellowship, which shall extend through a period of *Two Years* from the date of appointment of the Fellow, *The A. B. Company* agree to pay *Five Hundred Dollars* per year, payable annually, to the University on the *First of March.* This sum shall be paid by the University in monthly instalments to the holder of the Fellowship.

Any and all discoveries made by the Fellow during the tenure of his Fellowship shall become the property of *The A. B. Company* subject,

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* The written parts of the agreement are printed in italics.

however, to the payment by them to the Fellow of one-tenth of the net proceeds arising from such discoveries, it being understood that the Fellow shall be regarded as the inventor. At or before the expiration of the Fellowship, the business services of the Fellow may be secured by *The A. B. Company* for a term of *Three Years* on condition that the terms of such services are satisfactory to both parties at interest.

It is also understood and agreed that, on the expiration of the Fellowship, the holder thereof shall have completed a comprehensive monograph on *The Chemistry of Laundering* containing both what he and others have been able to discover. A copy of this monograph shall be forwarded to *The A. B. Company,* and a copy shall be signed and placed in the archives of the University until the expiration of three years from that date, when the University shall be at liberty to publish it for the use and benefit of the people.

It will be seen that this Fellowship affects three different parties: The Industry, the University standing for the people, and the Fellow appointed.

As for the Industry: The A. B. Company is concerned with the manufacture of Launderers' materials. This Company believes that the Laundry business, while along mechanical lines it may be considered to have reached a condition of what might be called terminal perfection, along chemical lines is conducted on a basis of almost mediæval ignorance; that it has been developed upon the slenderest knowledge of the material of cotton and linen textiles; and that it is practised with a joyous disregard of the whole body of modern chemical knowledge. It believes that the chemical methods of the present-day laundry can not only be changed, but radically changed; and it also believes that this change must be initiated from the outside—that its own chemists cannot solve its problems. Consequently, the Company has appreciated the opportunity of founding in this progressive University in the West a Temporary Fellowship for the solution of this one specific problem, for it sees that in combining the "inside" knowledge and big facilities of its factories with the special knowledge and trained action of the University and its Fellow, there lies a sane practical chance of a happy solution. It is willing to offer the Fellow appointed not merely the yearly $500 which constitutes the stipend of his Fellowship, but, in addition, one-tenth of the value of all that he can discover, as well as, ultimately, a permanent position with the Company on a mutually satisfactory basis—one-tenth, because a tax of a tithe upon a successful innovation in factory practice can never be burdensome, and a permanent position, because, if the Fellow succeeds, the Company must have him, and, whether or not, it always needs "good men."

The University, listening, as becomes a State University, with its ear to the ground, and unlike those institutions that are concerned only with their own self-perpetuation, has heard the murmurs of the people. Indeed, who has not? For, as a matter known by everybody and freely yet regretfully acknowledged by laundry men themselves, the course of the shirt to the laundry is one of swift and progressive disintegration. Since the people of this country pay a laundry bill of nearly twenty-five million dollars a week, and, in addition, vastly more than this in replacing fabrics which the laundry destroys, the solution of this problem is of unquestionable importance to their welfare. The University, therefore, in behalf of the people, is willing to extend its advice and facilities to the industry concerned, but—and in this "but" there lies the whole function of the University—it insists that the knowledge obtained within its gates should in a reasonable time become the common property of man. This is conserved by the agreement that, before the expiration of the Fellowship, the Fellow shall have completed a comprehensive monograph fairly exploiting all that he and others before him have succeeded in discovering. This monograph, after giving the Company three years' advantage, the University will publish. This does not mean that the Fellow and the Company are prohibited from taking out, at any time, patents on discoveries with industrial likelihood; but patents generally convey but a small proportion of the knowledge requisite for working them; and so, through this monograph, the means of using these patents after their expiration, and of improving them before their expiration, will be conserved to the people.

As for the Fellow appointed to the task, he pits his youth and strength and training and creative ability against a problem which the Company, with its inner knowledge of the conditions of the business, believes to be solvable. He is eager enough to attempt his devoir, because, while guaranteed a sum adequate to support him and sufficient time to make his achievement, he is guaranteed also a fair share of the spoils should he succeed. It is a game in which he has a reasonable chance of winning anything from zero to a million, and he is assured of the "square deal." What more can be desired by a young man at the threshold of his activity, even if it means that he must leave the "nook merely monastic" of a professor in embryo for a life of industrial alarums and strenuous war? In addition, he has in the monograph which he writes the opportunity of proving himself a supreme authority in this limited but important field; he has, if he wins, an assured position by which he may take a notable part in what in these days is the preferred work of the world, the doing of real things, the turning of knowledge into useful ends; and then, too, his work may all be carried on in strictest accordance with the science in which he has been bred.

Finally, a rereading of this agreement will show that it is essentially one of trust. The University stands sponsor to this arrangement, because, in any particular instance in which the foundation of a Fellowship is accepted, it will first convince itself of the integrity of all concerned. For that reason, the foregoing agreement, for example, has been drawn in a broad and liberal spirit, and it thus stands to the young men in the University as a demonstration that opportunity waits not only upon training and ability, but, first and foremost, upon a reputation for absolute integrity.

Everywhere throughout America, wherever there is the smoke of a factory chimney, there are unsolved, exasperating, vitally important manufacturing problems—problems in glass, porcelain, starch, tanning, paints, drugs, meats, iron, oil, metallurgical products — problems wherever man deals with substance. It seems clear that these problems can best be answered by combining the practical knowledge and the large facilities of the factory with the new and special knowledge of the universities, and by making this combination through young men who will find therein success and opportunity.

A Temporary Industrial Fellowship does this; it affords a young man every incentive to lay his hands on the vast body of correlated knowledge called Science, and to make it subserve the practical needs of the human race.

ROBERT KENNEDY DUNCAN.